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ABSTRACT

This report focuses on use of large-scale economy-wide models in Australia for occupational forecasting and their use in the vocational education and training (VET) sector for making decisions about training profiles across occupational areas. Section 2 reviews objectives of VET policy as defined in the legislation and Australian National Training Authority annual reports. Section 3 provides a non-technical overview of international perspectives on the role of occupational forecasting in VET planning and identifies informational requirements of VET planning. Section 4 reports the views and practices of personnel in the VET sector relating to use of labor market projections. Section 5 discusses economic modeling, including the: nature of economic models, constructions of models, different types of economic models, model uses and limitations, and implications of VET requirements for model design and structure. Section 6 describes development of major economic models; reviews research of comparative model evaluation; describes major recent developments in the Monash and Murphy modeling capability; examines the National Institute of Economic and Industry Research model, modern multi-country general equilibrium models, and the latest modeling methodologies used for occupational forecasting overseas; and examines strengths and weaknesses of these approaches; and analyzes how they are used in the VET sector. (Contains 80 references.) (YLB)

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# Labour market models and their use in projecting vocational education and training requirements

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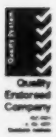

# Contents


Acknowledgements ..... iv

Executive summary ..... v

1 Introduction ..... 1
- Aim of report ..... 1
- Organisation of report ..... 1

2 Objectives of VET policy ..... 3

3 Occupational forecasting and VET ..... 5
- Rationale for occupational forecasting ..... 5
- Information requirements for labour market decisions ..... 6

4 Labour market forecasts: Users' views and practices ..... 9
- Overview of responses ..... 9
- Responses from VET organisations ..... 10
- ANTA ..... 12

5 Alternative modelling approaches ..... 14
- Background ..... 14
- VET requirements and model structure ..... 15
- Desirable properties of models ..... 15
- Limitations ..... 16

6 Comparison of Australian occupational forecasting methodologies ..... 18
- Previous comparative studies of economic models used in policy analysis ..... 18
- The Monash model: Current status and planned developments ..... 22
- Murphy methodology ..... 24
- The NIEIR model ..... 26
- Other modelling methodologies ..... 27

7 Summary and policy recommendations ..... 29
- Policy recommendations ..... 30

References ..... 32

Appendix ..... 36

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# Executive summary

Because much of the policy relating to vocational education and training (VET) has continued to evolve since the radical changes experienced in this sector as a result of industry restructuring of the 1980s, many of the objectives associated with policy development within this area have not been as clearly defined or articulated as perhaps would be desirable. For example, it is difficult to locate clear objectives attached to VET policy in either the relevant legislation or the annual reports of the Australian National Training Authority (ANTA). In part this reflects the rapidly changing industry (and therefore, training) environment of the 1980s whereby insufficient time was available for consideration of the appropriate roles of public and private sectors in VET provision.

Similarly, while ANTA has indicated that model-derived employment forecasts are an important component of planning processes in the VET sector, it would appear that nowhere is the role of labour market models and occupational forecasting clearly defined. Historically there has been use worldwide of large-scale economic models for manpower planning and VET purposes for over fifty years.

In part response to policy directives, the energies of the VET sector appears to have focussed energies more on 'organisational efficiency', mobility and equity matters than on identifying which training services offered by the sector are most valuable and relevant to the requirements of industry.

The substantial economic literature on labour market behaviour and policy identifies several reasons for government intervention in VET areas: labour market information has 'public good' characteristics and would therefore be underprovided if left to the private sector sources; capital market imperfections may prevent young and unskilled workers from investing appropriate amounts in VET.

The prevailing view of VET research worldwide is that current and timely information on changing labour market conditions improves the decision-making of all current and potential labour market participants, especially where long lead time in skill acquisition is required.

This information must be available at a highly disaggregated level and should identify likely imbalances between demand and supply in occupational labour markets rather than simply attempt to make employment forecasts.

Such labour market information must build upon both occupational demand and supply data, taking into account workforce outflows, population growth by age and sex, net migration, changes in participation rates, projections of skill categories within new labour supply, and effects of labour supply substitutions between occupations.

This information should also take account of the likely changes in wage relativities and their impacts, as well as the related issue of the time lags required to overcome market imbalances.

A key issue, which appears not to be not addressed in VET-related economic literature or policy statements, is that the value (to the economy as a whole) of removing imbalances in one occupation rather than another, depends upon factors such as the relationship between price and marginal cost for the product concerned.

Although most State training authorities purchase and/or develop their own model-based occupational profiles, the use of labour market models appears to be at best ad hoc and at worst ignored.

Reasons reported for the use of occupational profiles related less to the need for forecast accuracy, but rather took account of factors such as heavy weightings given to expenditure patterns in previous years, political pressures to 'consult' widely and pressure from particular groups (for example, industry training advisory bodies [ITABS]) to be consulted.

A further constraint restricting the use of labour market models is reported to be a lack of staff with the economic and econometric training necessary to apply modelling techniques to VET planning.

It was reported that significant staff cuts have taken place in the VET sector in all States, and that these cuts have had significant impact upon staff with modelling and related quantitative skills.

Economic models used for occupational forecasting should include the following characteristics:

- The separate parts of the model should have overall consistency.
- The model should make use of the informational content of economic theory.
- Parameters describing behaviour within the model should be estimated appropriately from market data.
- It should be possible for independent researchers to replicate results claimed to have been derived from a particular model.

Forecasts obtained using economic models depend upon both how well the model used approximates behaviour in the economy, and upon how well-forecasted are the trends in the outside (exogenous) variables that 'drive' outcomes from the model.

Two types of forecasting exercise may be distinguished: those that build upon the 'most likely' values and trends of outside (exogenous) variables; and scenario analysis, where the consequences of a particular, but not necessarily likely, economic shock (such as a hydro-carbon tax) are investigated.

Whichever types of forecast are derived, it is extremely difficult to provide information on the probability of any particular variable taking a value in a given range. At best, sensitivity analysis may be undertaken to suggest the extent to which outcomes may vary in different situations. Alternatively, historical performance may be taken into account.

For some time Australia has been, and remains, at the forefront of economic modelling developments, both in relation to large-scale disaggregated economy-wide models and to smaller dynamic macroeconometric models.

In particular, the Monash and Murphy models used widely in the VET sector are large-scale disaggregated models with dynamic macroeconomic sectors that substantially meet the model criteria detailed above. The slightly smaller National Institute of Economic and Industry Research (NIEIR) model only partially meets these criteria.

The smaller-scale multi-country McKibbin G-Cubed models are also leading-edge examples and, as with the macro-focussed Treasury TRYM model, also substantially meet the model criteria above, but lack the disaggregated detail so necessary to VET requirements.

Existing Australian modelling methodology does not model labour supply adequately for VET purposes and, at best, gives minimal direct information about likely occupational labour market imbalances.

Both the Monash and Murphy models contain some dynamic aspects, and the Monash model has signalled development of supply-side considerations. Nevertheless, at this stage only the Murphy model offers some insights relating to labour market adjustment behaviour, insights which cannot however, be deduced by the subscribers themselves from the forecast information currently provided, even though this could easily be achieved.

Overseas occupational forecasting methodology, such as that undertaken in Canada, has a far more detailed framework for dealing with adjustment in labour supply and may provide pointers for further developments in Australian labour market models.

The Canadian methodology, however, has significant limitations in relation to demand-side modelling, the level of disaggregation and also to the use of flow projections. Specifically, while labour market flows are predicted, no information is offered about the skills environment in which these flows take.

Notwithstanding the limitations applying to all current occupational forecasting methodologies, it must be understood that a coherent organisation of theory, understanding and data within a modelling framework is generally a superior method of forecasting to one based upon unstructured use of 'expert' opinion on particular markets or sectors.

By worldwide standards, Monash University offers an outstanding resource base for methodological developments of the kind signalled in this report. In addition, there is every indication that these resources are being used in a proactive manner to enhance Monash methodology based upon the identification and understanding of VET sector needs.

## Policy recommendations

1 Drawing on the insights available from models of labour market behaviour and economic policy analysis, the role of the public sector in some VET sector activities, specifically those relating to labour market supply and demand, should be reconsidered, with a view to clarifying:

- whether the focus of the public sector should be to provide information on projected labour market imbalances in order to improve industry decision-making in the various occupational labour markets
- under what circumstances projected imbalances can be addressed efficiently through private sector demand-side and supply-side decisions, without public sector interventions in these markets
- for those occupational labour markets where public sector interventions (other than information provision) can be justified, the basis upon which the relative importance of imbalances in different markets can be established

2 On the basis of the first point above, ANTA should review its definitions of the objectives of VET policy and of the key performance measures that derive from policy objectives.

3 It is desirable that the national and State agencies concerned with the design and application of VET policy maintain within their organisations, some expertise in the application of economic analysis, modelling and forecasting to VET issues.

4 A key research priority is to improve the labour market dynamics of models, especially in regard to the treatment of occupational labour supply and replacement demand, as well as to likely occupational wage adjustments. In this way, the capacity to forecast occupational labour market imbalances will be increased.

5 A further research priority is to develop the model's capacity to indicate the relative value of reducing labour market imbalances for one occupation as opposed to another.

6 It is desirable that the research priorities identified in 4 and 5 above be undertaken in a way that utilises the leading-edge skills of the Australian economic modelling community, especially those exemplified by the Monash and Murphy methodologies.

7 Incentives should be provided for a focussed program of research which, while encouraging further developments on the Monash and Murphy models, should avoid encouraging duplication of research activity between different modelling agencies.

8 The possibilities for collaborative model development should be explored but not to the extent of precluding an ongoing process of model comparison and evaluation.

# 1 Introduction

Vocational education and training (VET) is crucial to the development of a productive and competitive economy. The Australian National Training Authority (ANTA) was established in 1992 under the *Australian National Training Act*. This act resulted in the formation of a statutory body directed by an industry-led board whose role it is to advise relevant Commonwealth, State and Territory Ministers. ANTA is responsible for the development of, in relation to VET, national policy, a national strategic plan, goals and objectives as well as State training profiles.

In 1998 ANTA sought to initiate a program of research and evaluation into vocational education and training. The National Centre for Vocational Education Research (NCVER), is managing this program. This paper is an outcome of that program.

## Aim of report

A variety of labour market demand models is used in Australia at a variety of levels within the VET sector. These models are used to make decisions about national, State/Territory, regional and sectoral and local training profiles. Information can also be purchased from a variety of sources.

This paper focusses primarily on the use of large-scale economy-wide models available in Australia for occupational forecasting and their use within the VET sector for making decisions about training profiles across occupational areas at national and local levels.

This paper has a number of objectives including:

- to provide a brief and clear definition of the objectives of VET policy
- to identify the reasons why model-users in the VET sector make use of various modelling frameworks
- to identify the particular models (or model types) currently used
- to provide general reviews of the range of models (or model types) currently available, including their strengths and limitations, especially in regard to the requirements of VET policy
- to evaluate the use of economic and econometric models in assisting VET decisions, both in relation to models currently used and to other approaches which might be undertaken, making a brief comparison with VET practice in Canada
- to make recommendations based upon the preceding objectives

## Organisation of report

The organisation of this report reflects the requirement that the contents should be accessible to readers of different backgrounds. Section 2 offers a brief review of objectives of VET policy as defined in the legislation and in annual reports of the Australian National Training Authority.

Neither the legislation nor the ANTA reports give much indication of the role of labour market modelling. In section 3 of this report therefore, a non-technical overview is given to

international perspectives on the role of occupational forecasting in VET planning. From these considerations the informational requirements of VET planning activities are identified.

Section 4 reports the views and practices of personnel in the VET sector relating to the use of labour market projections. The material presented here is based mainly upon in-depth telephone interviews with senior representatives of State and national bodies associated with VET activity in Australia. VET sector research publications as well as information provided by the modellers themselves were also consulted.

In section 5 an introductory discussion of economic modelling provides a bridge between the non-technical discussion in section 3 and the more formal exercises of model comparison that follow later in the report. Topics dealt with here include the nature of economic models, the constructions of models, different types of economic model, model uses and limitations and the implications of VET requirements for model design and structure.

Finally, in section 6, we come to the heart of the report—an evaluation of the use of economic and econometric models in assisting VET decisions. Significant but not exclusive attention is given to models currently used within the VET sector, especially the Monash and Murphy models. The development of the major economic models is described and a review of previous research of comparative model evaluation is presented. Detailed descriptions are provided of the major recent developments in Monash and Murphy modelling capability, special attention being paid to their labour market forecasting services. Attention is also given to the National Institute of Economic and Industry Research (NIEIR) model, modern multi-country general equilibrium models, as well as to the latest modelling methodologies used for occupational forecasting overseas.

The strengths and weaknesses of these different approaches are examined and the manner in which they are used within the VET sector is analysed. Australia is fortunate in having leading-edge modelling methodology and models locally and readily available. Further research must be undertaken to derive information of the type most likely to be of value to VET planners. This additional information could be used to support and enhance existing labour market models for use in the VET sector.

To obtain the maximum value from Australia's outstanding modelling capability, the VET sector will also need to review the role they accord to model forecasts and to their own manpower and skill needs in this area.

# 2 Objectives of VET policy

The nature and objectives of the national vocational education and training system are clearly defined in the most recent annual report of ANTA (1998a). The system is based upon a co-operative arrangement between the Commonwealth Government and State and Territory Governments, industry, industry training advisory bodies (ITABs) and various other stakeholders.

The *Australian National Training Act 1992* established the industry-led statutory body, ANTA and the ministerial council to which ANTA is responsible. Under the 1992 act, ANTA is responsible for development of, and advice on the direction of national policy, the associated goals and objectives, a national strategic plan and State training profiles, all of which are finally determined and approved by the ministerial council.

ANTA is not only an advisory body but it is also responsible for both the funding and administration of the national VET system. ANTA also deals with the State training authorities which have delegated responsibilities of VET activity within individual States.

In 1997 a revised ANTA agreement was endorsed. This revised agreement clarifies the key objectives of the VET system as well as specifying planning and accountability arrangements. Following consideration of the views of both industry and of chief executive officers of various VET systems, it was determined that the mission of the system was to:

> *Ensure that the skills of the Australian workforce are sufficient to support internationally competitive commerce and industry, and to provide individuals with opportunities to optimise their potential.* (ANTA 1998a, vol.1, p.6)

This statement could be criticised in that it fails to specify the need to determine *optimal* levels of skills provision and to identify appropriately priority training areas. Nor is it clear what is meant by the notion that individuals should 'optimise their potential'. Certainly it offers no insight into the role economic models might play in VET planning.

In addition to the formulation of the mission statement above, the 1997 ministerial council also identified five key objectives as a basis for the development of a national strategy:

1 *equipping Australians for the world of work*

2 *enhancing mobility in the labour market*

3 *achieving equitable outcomes in vocational education and training*

4 *increasing investment in training*

5 *maximising the value of public vocational education and training expenditure*

(ANTA 1998a, vol.1, p.6)

While these objectives do offer a broader picture of the role envisaged for the VET system, the list is not without its problems. For example, the fourth objective is clearly based upon the unproven proposition that there is currently too little investment in training, while the fifth objective only becomes meaningful if it is also defines how 'value' is to be measured.

Both the mission statement and the list of key objectives raise questions about whether the ministerial council is fully aware of the complete range of issues implied by optimal support for and management of a VET system. The discussion in the 1997 annual report regarding State and Territory training profiles is similarly problematic: the 1997 training profiles were to

**be structured around key priorities regarded as critical areas for development, and specifically, the profiles should accommodate seven strategic directions identified by the ministerial council in 1996.**

1 *deliver more apprenticeships and traineeship training*
2 *(be) responsive to and accessible by small medium enterprises*
3 *foster labour mobility throughout the Australian economy*
4 *give business a key role in leadership and provide training relevant to business*
5 *devolve administrative and delivery mechanisms to ensure responsiveness to clients*
6 *(become) more efficient through the use of flexible and competitive delivering arrangements, and*
7 *have regard to the principles of access and equity*

(ANTA 1998a, vol.1, p.3)

Even the more recent *Bridge to the future* and *Key performance measures* publications (ANTA 1998b, 1998c), fail to significantly address the limitations identified above. As will emerge from discussion later in this paper, the loose policy guidelines and discussions of objectives offered do not appear to have been based upon the necessary consideration of the appropriate roles for private and public sectors in VET provision.

The lack of specific guidance in the legislated acts and in ANTA's own reports has left much to the discretion of the State training authorities. There have been two broad directions followed in their responses: the first has been to obtain access to employment profile forecasts of one kind or another from leading economic modelling agencies, and the second has been to direct many of their activities in line with State objectives and strategic directions proposed by ANTA and by the ministerial council.

Questions regarding the choice of occupation forecasts made by the different authorities, and the use made of such forecasts is detailed in section 4 below. Here it will be noted that while there is widespread acknowledgement that such forecasts should be obtained, there is also clearly a great deal of uncertainty as how to best use such data. In most cases the weight given to forecasts appears to be low compared to that given to industry and other expert opinion. It should be noted, however, that at least two of the State authorities have explored developing their own forecasting capabilities.

Close reading of volume 2 of the 1997 ANTA annual national report supports a view that the role of employment profiles in VET is not well understood and consequently plays a small part in the overall activities of the State authorities. Instead the focus of activities within each of the States as indicated by the report appears to be compliance with the four themes identified in *Towards a skilled Australia: A national strategy for vocational education and training, 1994–97* (ANTA 1994): greater responsiveness; enhanced quality; improved accessibility; and increased efficiency.

To understand why such a focus might be problematic it is useful to compare the provision of VET services with the provision of any other goods or services provided in the private sector. In the latter case the failure to deliver a product valued in the market place would spell failure for a private organisation, no matter how efficient the internal organisation structure, the distribution channels and the purchasing departments of the business in question. In an important sense VET providers face a similar challenge—to deliver as efficiently as possible the *most valuable* service they can subject to the resource constraints faced. The overriding impression from the annual report is that very little of the training authorities' energies have so far been directed to question of which training services are the most valuable.

# 3 Occupational forecasting and VET

In the context of the lack of specific attention paid to the issue of occupational forecasting in either the acts defining the role of ANTA, or in subsequent annual reports of the authority, it is appropriate that the matter be addressed briefly here. Two issues are relevant: the rationale for occupational forecasting and the factors that need to be taken into account when making occupational forecasts.

## Rationale for occupational forecasting

The compilation of occupational forecasts generally precedes much of work involved in the development of economic analysis of labour market behaviour and the role of policy. It also precedes the important steps of econometric modelling and forecasting methodology which have advanced manpower planning capabilities over the last ten years or so.

As noted in Boothby, Roth and Roy (1995), extensive use of projects was made to assist manpower planning in major western countries during both mobilisation and demobilisation activities at the time of World War II. Similarly, Leontief and Hoffenberg (1961) made use of a highly disaggregated input–output model to provide insight into the aggregate and occupational (un)employment implications of ending the Korean War.

Criticisms of these early approaches in the 1960s, summarised in Ahamad and Blaug (1973), include concerns relating to the inability of early models to deliver sufficiently accurate and detailed predictions to guide planners, reactions against over-regulation of student choices in relation to training, and arguments that education and training were too weakly linked to occupation for long-term employment forecasts to yield useful information on education requirements. From these early initiatives two strands of research which impacted upon manpower policy emerged. On the modelling and forecasting side, attention was turned to towards short-to-medium-term forecasting and the development of more general modelling frameworks, breaking away from the simple fixed-technology assumptions of the standard input–output approaches and paying more attention to questions of dynamic adjustment. Modelling considerations will be dealt with more fully in sections 5 and 6 below.

The second strand of research and which is of direct relevance to VET consideration involved the development of models of labour market behaviour and the choices likely to be made by both employers and employees with regard to education and training. These developments, which are summarised in good comprehensive modern texts such as that by Lazear (1998), build upon human capital theory and yield important insights into the implications of the distinctions between formal education, general on-the-job training and firm-specific on-the-job training, as well as into the role of labour market information.

The implications of human capital theory are well understood. Briefly, firms have no incentive to provide general on-the-job training but, subject to financial, informational and other constraints, workers will undertake the appropriate amount and type of training of their own accord. In relation to firm-specific training, while the trained worker continues to be worth more to the firm in question than to outside employers, then firm and worker should share in the provision of training.

Leaving aside the question of whether, even with perfect information, decisions made by the private sector would lead to optimal choices of the quantity and type of training from the point of view of society as a whole, it is clear that all choices regarding formal and on-the-job

training are likely to be improved if better-quality occupational labour market information is available.

Together, these strands of labour market research have contributed to a review of the purposes and uses of occupational forecasting. The new directions now largely followed, and the tighter analytical frameworks underlying recent approaches, are the subject of various contributions to the literature, including the Boothby, Roth and Roy (1995) paper, Heijke (ed.) (1994) and the Australian contributions summarised in Centre of Policy Studies (1999a, 1999b) and Murphy and Douglas (1998).

The purpose of occupational forecasting is now widely perceived as providing a source of information for employers and potential employees regarding future labour market conditions by occupation and in relation to the type of education. In particular, information should be directed towards identifying likely future *imbalances* between demand and supply across occupations in order to improve the investment decisions of both employers and employees. Where occupational forecasts have been prepared for, and used on this basis, as noted in Hughes (1994), there is evidence that this information has reduced the costs likely to have arisen from uninformed labour market decisions.

In sum, the prevailing views in recent worldwide VET research relating to the use of labour market information are that:

- Information on rapidly changing labour market conditions is an essential ingredient of a well-functioning labour market.
- Such information improves the decision-making of students and unemployed as well as employers and employees with regard to education and training.
- Such information is especially valuable where long lead times in skill acquisition are required, both in relation to meeting demand and to avoiding costly mismatch.
- Education and training providers can also plan and deliver more effectively on the basis of advance information of labour market conditions.

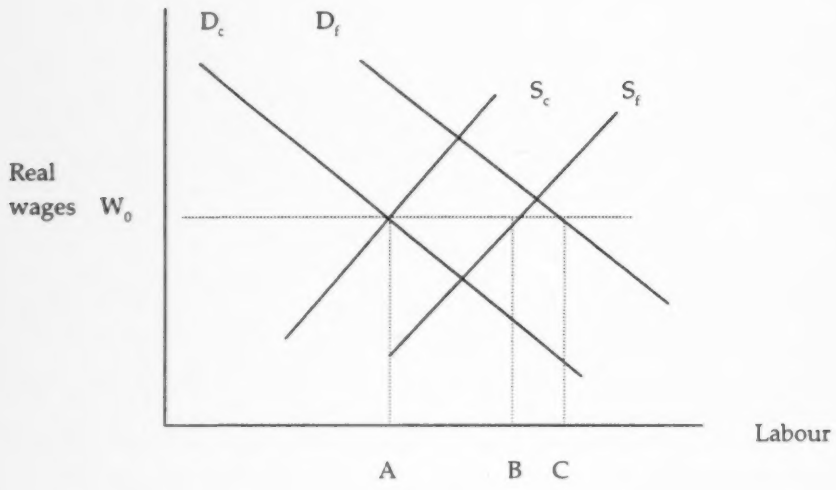
What these views fail to provide, however, is a more detailed consideration of the particular kinds of labour market information required in order to ensure optimal labour market choices of the type signalled above.

## Information requirements for labour market decisions

From an overall VET perspective, it is clear that information about likely imbalances across occupational categories is sought at the most disaggregated level possible. The educational and training requirements associated with different occupations, the time lags involved in appropriate skill acquisition, as well as the costs involved would also be relevant. These statements, however, are too general and elaboration is clearly required on the kind of information needed to adequately convey and usefully capture 'labour market conditions'.

The first point that needs to be reinforced is that it is *the imbalance between demand and supply* which is required, not simply information regarding change in the pattern of demand. This point is demonstrated quite simply in figure 1 below, which illustrates demand and supply in a particular market at two different points in time. Current demand and supply are denoted $D_c$ and $S_c$, future demand and supply by $D_f$ and $S_f$. Real wages are measured on the vertical axis and initially assume that real wages ($W_o$) are to be maintained at their current level.

**Figure 1: Measuring labour market imbalance**




Note that the purpose of the diagram is to illustrate general informational requirements rather than to suggest that any one outcome is more likely than any other. What can be seen immediately is that, if only the growth in demand were considered and if the current real wage were maintained, it could be correctly stated that employment demand was going to increase by the amount AC. This in itself, however, says nothing about whether a labour shortage in this future time period is likely. To identify a likely shortage, information is also required regarding labour for this particular market.

If the change in labour supply shifted over time as shown in figure 1, then the labour shortage would only be that reflected by the distance BC. Equally clearly, had labour supply been likely to increase by a greater amount, then instead of a labour shortage in this market, there would have been an oversupply.

It is apparent that for each market, labour supply information is required. This in turn requires estimates of a range of variables:

- outflows from the current workforce (retirees, quits and perhaps, lay-offs)
- population growth, by age and gender
- net migration impacts upon labour supply
- changes in participation rates
- projections of skill categories within new labour supply
- the effects of labour supply substitutions between occupations

This list is not exhaustive and at least two further interrelated factors need to be considered before estimates of occupational imbalance can be obtained. First, any given shifts in labour demand and supply can produce either shortages or over-supplies depending upon the adjustments which occur to the real wage. Supporters of deregulation in labour markets would of course wish wages to rise in occupations where there are labour shortages in order to signal to the market that training is required in these occupations.

A problem here is that shortages in some areas may involve training over a significant period of time. While it is true that even in these cases a sufficient increase in the real wage could eliminate any imbalance between labour demand and supply, this would also increase the costs and reduce the competitiveness of the organisation concerned.

All of this indicates that the forecasting of occupational imbalances is a complex and difficult process. It also reinforces the need to understand the limitations of occupational forecasting and to exercise extreme care in posing the questions which it is hoped such forecasting can answer.

In fact there is a further complexity that needs to be addressed if occupational forecasting is to offer a useful basis for the allocation of scarce education and training resources between alternative uses. Suppose that on some criteria or another it could be identified that two occupations were likely to exhibit similar and significant labour shortages in some future period. Suppose also that real wages and training costs were similar for the two occupations. It might seem that scarce training resources would best be allocated approximately equally between the two occupations, but this is not the case. Depending upon factors such as the relationships between price and marginal costs in the product markets associated with these occupations, society may benefit far more from the allocation to training in one occupation than to the other.

# 4 Labour market forecasts: Users' views and practices

To understand more adequately the use of labour market projections in VET planning policy it was decided to approach key VET groups throughout Australia. This section provides a brief outline of their stated use of labour market projections.

During February and March 1999, a number of organisations who use labour market projections in their education and training planning were approached for interview. Individuals in each organisation who could assist with the project were identified and contacted by phone. After explaining the purpose of the project, each individual agreed to an interview. There were no refusals. Each interview lasted between 15 and 35 minutes.

The purpose of the interviews was to elicit views regarding the usefulness of information received from suppliers of labour market projections. The interviews, although largely unstructured to permit maximum opportunity for discussion, focussed on several key questions. These were:

- In your planning process, do you use labour market projections derived from labour market models?
- Who supplies this information?
- What types of information do they supply?
- How is the information you receive used to assist in projecting training requirements?
- How useful is the information you receive?
- Does your organisation have any written policy guidelines regarding the use of this information?
- If you were asked to weight the importance of the information you receive in your projections, what would that weighting be?

In some instances individuals were contacted more than once to improve the detail of response.

## Overview of responses

Relevant VET organisations in all States and Territories as well as a number of national bodies were contacted for information about their use of labour market models in the 'planning process'. It would appear that the use of such models is at best ad hoc and worst they are completely disregarded. In almost every case the respondent claimed that any 'input' from labour market models formed only one part of the process and that various forms of 'triangulation' were used to 'check' any predictions from labour models. The reasons given for this were not necessarily 'doubts' about a model's predictions (although all agreed they were 'predictions of uncertain accuracy') but related to the function of other factors such as:

- the heavy weighting given to expenditure patterns in previous years
- political requirements to 'consult' widely
- pressure from other groups (for example, ITABs) to be consulted
- a lack of trained staff; this meant planners were unable to come to grips with the econometrics and assumptions involved with labour market models and so they sought other sources

- an unwillingess by 'planners' (as a group) to be 'tied down' by predictions from models and their desire to have a more 'common sense' method of estimating training requirements
- an assumption that industry groups know better
- policy requirements to rely on other methods (for example, qualification imbalance)

There would appear to have been significant staff cuts in all States in the VET area over the past few years. These cuts appear to have particularly affected those staff with quantitative and modelling skills. Thus there may be considerable uncertainty about the usefulness and applicability of labour market predictions on the part of senior planners and those with responsibility for producing the final training estimates. This may result in increased emphasis being given to alternative information sources, particularly those with specific business and training links, and an under-emphasis on the projected data they receive.

The responses indicated that none of the State or national bodies had a written set of protocols or procedures which formally outlined how labour market predictions were used. There were no detailed policy documents although there were some publicly available brochures that stated 'best practice', the 'latest available information' were used in training predictions.

The data received by VET personnel were all perceived as being based on labour demand models. With the exception of one State, little attention appears to be paid to issues of labour supply.

## Responses from VET organisations

*The responses below represent a detailed compilation of the interviews conducted early in 1999. Following suggestions from referees, these responses have been combined to ensure no State can be easily identified. Only the ANTA response has been identified.*

### Labour market model supplier to State or Territory

The model suppliers included:

- ECONTECH (the Murphy model) – 3 cases
- The National Institute of Economic and Industry Research (NIEIR) (Peter Brain's model) – 1 case
- Monash group – 4 cases. In one case, no formal labour market model was supplied or used

The range of responses to the questions outlined earlier was greatly influenced by the size of the economy under consideration and the resources devoted to labour market issues. Thus any synthesis of views will, at first glance, include some apparent contradictions. Nonetheless, several consistent themes emerged from respondents.

In most cases, information from labour market models was not accepted uncritically. In some cases there was an attempt to overcome perceived shortcomings in supplied information by addressing the same issues in-house. For the majority, however, the preferred approach was to 'calibrate' any model predictions against a range of other sources, typically anecdotal, and simultaneously bring in 'other players' for political as well as modelling reasons.

A variety of factors informed the final forecasts produced at State and Territory level. The sophistication of this process and the factors used were a function of the size of the economy, the resources available within the organisation to devote to these forecasts (both in quantity and quality terms), and the political pressure felt by the organisation (directly from the political process and also from industry groups). An important consideration was also the degree of 'inertia' generated by previous predictions and subsequent labour market expenditures. The factors used to assist with predictions included:

- historical growth trends; for example, whether predictions are within historical 'limits'
- estimates of the VET workforce

- estimates of gaps in VET training provisions
- perceived gaps in a State or Territory's overall qualification levels
- the influence and predictions of ITABs (especially where the quantitative methods were less emphasised)
- local consultancies who understand industry development directions
- a small number of local industry 'experts'
- published business expectations
- focus groups
- work groups
- government policy

Typical rules of thumb also employed included limiting changes in predictions to not more or less than about five per cent per year and ensuring assessment by ITAB personnel of the credibility of the predictions. No one organisation used all of these approaches.

In many instances, any data produced by the labour market models were used to 'set parameters' for views proffered by industry experts and consulting groups. Formal weighting of supplied model data was never done, nor were margins of error placed (or apparently sought) on labour market forecasts. As a whole, the overwhelming response was that the whole process of predicting training requirements was essentially ad hoc, combining various levels of quantitative information from models, with various amounts of market intelligence.

Respondents noted a number of difficulties associated with using labour market models. Of particular concern was the level of aggregation of labour market models and the subsequent difficulties which arose when predictions based on a more detailed level of information were required. There have been difficulties, for example, in industries which are forecast to be in long-term decline, but where a model projects short-term increases. Another difficulty with using labour market projections is that they are industry-specific while many occupations are generic. Thus the projections of labour market models tend to match in some areas (where industry and occupation are coincident) and not others. Areas such as information technology are a particular example of this difficulty, as IT skills are frequently generic and the demand for them is difficult to predict by industry classification.

There has also been a recognition that labour market-based models may not be useful in situations where occupational growth is heavily dependent on community-based planning. This is particularly evident in rural regions, where the demand for training is as much a function of community approaches to labour and employment as it is of local economic conditions. Also mentioned as a difficulty with current labour model estimates was that they tended not to validate the quality of their projections as much as the users would prefer.

In cases where attempts were made to examine the underlying modelling assumptions in-house, the methods adopted included:

- examining attrition rates more closely rather than focussing on growth projections
- comparing 'field estimates' from specific industry studies
- attempting (where resources allowed) more detailed forecasts
- comparing earlier predictions against actual experience
- examining the assumptions that in all likelihood produced the difference between predicted and actual numbers

Other issues currently being examined include how the labour market models deal with migration, assumptions about replacement staff requirements, and labour supply issues more generally. To predict labour force in the past, a simple time trend approach similar to the ABS approach had been adopted by some organisations. When this survey was undertaken, a number of organisations were comparing log and linear trends. It was suggested that as with the approaches used by the Bureau of Labour Statistics in America, these simple approaches seem to give as good a result as any structural model. Simple approaches were also far cheaper.

In cases where no labour market models were used, reliance was placed on ABS data, information from government departments and local industry.

As the actual aim of the entire process is to produce information about the need for training, other factors (such as the industry's capacity to pay for training) are also important in predicting training requirements. These predictions would also be more reliable if, for example, more information were available about industry profitability, current trainee expenditure (by employers), attrition rates and the change in skills required by the workforce.

Adding to the difficulties experienced with predicting training requirements was a perception that the labour models were not particularly reliable, especially during the current period of significant labour market change. Even the categorical definitions of particular occupations and industries were becoming more problematic as these shifted with a changing economy. The general response to this was to rely less on quantitative methods, and more on consulting methods.

In several cases the process of prediction was thus more driven by 'contestability' than 'consistency'. Currently, the move is away from strategic planning and towards 'scenario' planning, a technique which has moved the process a little further away from the labour market models. Mention was also made of institutional opposition to changing resource allocations on the basis of labour market models. Several respondents noted that labour market models were more for 'public consumption' than actual decision-making and that the predictions offered by models had only a marginal impact on the allocation of dollars.

Whether an organisation relied on qualitative or quantitative approaches was generally a function of the skill level of the staff involved, and also the preferences of senior management. Where staff with quantitative skills were available, and senior staff were supportive, more quantitative methods were adopted. There was a general perception by respondents, however, that the quantitative approach had been eroded in recent years, both because skilled staff were no longer available, and because of the preferences of senior management. An important factor influencing the latter was the perception that labour market predictions were heavily political in nature. Furthermore, they required a rigorous quantitative basis to be effective.

Given reductions in resources to many organisations, several respondents mentioned the possibility of joint programs with parallel organisations in other States to improve the quantity and quality of staff and economic resources devoted to prediction training requirements, and thus predictive capabilities.

## ANTA

The labour market model used by ANTA had been supplied by the Centre of Policy Studies at Monash University.

ANTA respondents suggested that planning was always an imprecise and 'indicative' undertaking. Employment forecasts were, however, an important component of the planning process. As labour market models are unlikely to precise, particularly at the detailed level, other modelling approaches were also being investigated for use in predicting future (and replacement) demand. The qualifications gap approach was an example of this method. As part of the integrated approach to Key Performance Measure 2, *Stocks of vocational education and training skills against desired levels*, a range of planning techniques and data sources was currently being investigated.

Apart from key performance measure and planning model uses, data from labour market models forecasts are used, or are proposed to be used, in a number of areas. These include:

- examining trends in industry and occupational sectors
- general monitoring of employment trends overall
- industry and sector studies
- national training package implementation evaluation

- the identification of opportunities for training initiative development
- production of industry profiles
- the provision of background information to stakeholders

ANTA, as a national body, works closely with the States and Territories and the Commonwealth and must therefore be cognisant of the diversity of approaches used in these different jurisdictions.

# 5 Alternative modelling approaches

In the previous section it was indicated that three key modelling methodologies were currently utilised in VET. These models, the manner of their use and their applicability will all be considered in more detail in the following section. Initially however, it may prove useful to look briefly at the question of modelling from a more general perspective.

## Background

Expressed simply, economic models are mathematical representations of relationships between key variables in the economy. In most models the relationships fall into two categories: those which seek to characterise the behaviour of decision-makers in the economy by indicating relationships between variables arising from technological considerations, as in production processes; and those which reflect necessary connections between variables arising from definitions and take the form of accounting identities and which may involve quite large numbers of variables.

Of course, the actions of one decision-maker in an economy affect both the choices faced and decisions made by other decision-makers in an economy, as well having impacts through the economies of trading partners. The number and complexity of relationships which impact upon real world economies raise important questions about the kind of modelling approach that should be followed.

As a general rule it should be understood that all models are approximations and, in addition, computational considerations dictate that there is a trade-off between the number of relationships (the level of disaggregation) that can be modelled and the complexity of behaviour that can be modelled. Typically, models that attempt to capture the interrelationship of a large number of variables may need to embody simple mathematical characterisations of decision-making behaviour, both with regard to the variables involved and with regard to the dynamics of adjustment.

In part, because of the degree of complexity involved in attempting to capture all of the interactions within an economy, and because errors due to mis-specification in modelling one part of an economy could impact upon the usefulness of the model as a whole, some researchers have preferred to adopt simpler approaches. These have involved models focussing upon a single market, a single behavioural relationship or simply upon a single variable. Respectively, examples might include a labour market, the description of labour demand behaviour, and the simple prediction of employment. All of these alternative approaches might have an aggregate focus or relate to highly disaggregated market outcomes.

Among the factors influencing the choice of modelling methodology would clearly be the type of question to which an answer was sought. Whatever the level of disaggregation, all models have the characteristic that the outcomes for the certain variables in the model (endogenous variables or output variables) are conditional upon the values taken by (given to) some other variables in the model (exogenous or input variables).

Within this framework model-users explore two kinds of questions. The first involves scenario analysis and simply identifies the different values of the output or endogenous variables predicted by the model as a consequence of alternative input of exogenous variable specifications. The second question is far more complex. Here the values of input or

exogenous variables which are most likely to occur are determined. The model is then used to forecast the values of exogenous variables conditional on this 'most likely' input scenario.

## VET requirements and model structure

From the preliminary discussions on occupational forecasting informational requirements outlined in section 3, a number of the features necessary for a model for use within VET sector planning can be identified.

The first and most obvious requirement is that the modelling or forecasting framework must offer an interpretation of labour market conditions across different occupations and across different sectors of the economy. These requirements, in turn, can only be met in a framework that takes into account the ways that decisions and outcomes in one sector impact upon another sector; that is, VET requirements demand large-scale, economy-wide models with the capacity for a significant degree of disaggregation.

Usually such models are termed (computable) general equilibrium (CGE) models, this name encapsulating the essence of these models; that is, for a given specification of outside (exogenous) variables), 'equilibrium' values of endogenous variables are determined and can be computed. In the simplest case, constant values may be predicted for or assigned to these exogenous variables. This would lead to predicted equilibrium values of endogenous variables also being constant. Alternatively, changes in exogenous variables may be specified as constant rates of growth, in which case the model may yield predicted rates of growth for the endogenous variables.

It may be useful to relate these discussions of the use of models to an economist's view of the dynamics of the real world. Many variables central to decision-making in an economy are changing continuously. These changes may involve domestic and international variables. Importantly, they may be driven by technological change which itself will impact upon relative production costs and therefore product prices, as well as upon the real incomes of the individuals in the economy. Relative price changes as well as changes in both domestic and foreign real income influence both the pattern and quantity of goods demanded. Government interventions, through transfers such as pensions and benefits, as well as through sales and income taxes, will also impact upon demand.

The changes in demand will affect both the demand for labour in different occupations and sectors, and product prices. These changes, however, will influence and be influenced by both short-run and long-run adjustments in labour supply. The degree and speed of adjustment will depend upon both expectations about the magnitude and permanence of demand changes, upon the associated changes in product and factor prices and, importantly, upon the costs of adjustment. These costs clearly include those associated with core VET activities.

## Desirable properties of models

There is broad agreement among economists on the desirable properties of economic models and these have been discussed in some detail on numerous occasions, as by Wallis (1988), Burns (1990), in various Centre of Policy Studies publications as well as more recently by McKibbin (1998). The most important of these characteristics will be discussed briefly here, but not necessarily in order of importance.

First, a model should possess overall consistency, so that predictions from one part of the model cannot possibly be contradicted by predictions of another part of that model. An adequate demonstration of model consistency would require the availability of documentation which completely specifies all relationships in the model, including necessary accounting definitions.

Second, the specification of the different demand-and-supply relationships should be built upon widely accepted notions of maximising behaviour by organisations and individuals. Put another way, the manner in which relationships are specified should have an appropriate

basis in economic theory. An important dimension of this requirement is that economic theory also has something to say about the manner in which the variables included in these demand-and-supply relationships should be measured.

Third, the parameters which reflect the sensitivity of quantity variables to changes in prices and income should have, as far as possible, been estimated from market data using appropriate statistical methodology. Only by constructing models on this basis can it really be claimed that the predictions of the model are the outcomes that are most likely to occur in practice. Only with such an approach does it become possible to give some meaningful measure of the likely accuracy of any forecasts made.

There are other characteristics seen as desirable and which are mentioned elsewhere in this report. Among these is the view that it should be possible for the forecasts deriving from a particular model to be replicated by independent researchers. Additional desirable characteristics might include the availability of sufficient explanatory documentation to enable clients with some economic or business understanding to comprehend the basis of any forecasts made and a facility for regular updating of a model as fashion, technology and other factors change.

## Limitations

There are a number of factors that limit the usefulness of forecasts obtained through the use of economic models. It is particularly important to realise that 'accurate' specification of the relationships comprising an economic model is not solely sufficient for useful forecasts to be obtained.

The discussion in the early part of this section made it clear that even if all behavioural relationships were specified with total accuracy, it is still necessary to predict the trend behaviour of other variables driving responses by decision-makers in the Australian economy.

These other variables will include a range of (exogenous) factors outside the control of private sector decision-makers in Australia, such as rates of growth in productivity among Australia's trading partners, changes in Australia's future fiscal and monetary policy, and exchange rate movements. While some of these trends will be driven by completely unpredictable events, in other cases broad patterns may be predictable to a degree and such information clearly has some value.

This last point highlights two alternative approaches to obtaining forecasts using economic models. One relies upon forecasts of the most likely outcomes for the exogenous variables that drive changes in the model. The second approach, scenario analysis, is useful for consideration of the impact of a potentially serious shock to the Australian economy, even though the shock may be unlikely to occur or may simply be one of a number of alternative policy 'shocks' the government is considering bringing into effect. Examples of scenario analysis undertaken using economic models include forecasts of the impact of a hydrocarbon tax and, more recently, of a general goods and services tax (GST).

An important question that arises is how accurate are the forecasts made using economic models. Under ideal circumstances, if the parameters of a model and if the trends' values of the exogenous variables have all been estimated appropriately, a forecaster should be able to provide a 'confidence interval' for each forecasted variable and a stated probability level for the actual outcome which lies within that specified confidence interval or forecast range.

From a variety of factors discussed at more length in Burns (1991), and drawing on the work of others such as Leamer (1978), Denton (1985) and Lovell (1983), it is clear that in practice, useful information about confidence intervals will not be available. Thus, a good modeller may be able to claim that his or her model is likely to generate forecasts which, on average will be more accurate than those obtained otherwise, but which will not be able to indicate a range within which he or she is 95 per cent certain the actual outcomes are likely to lie.

Faced with this situation, potential users of economic models have a limited number of alternatives. In part, the historical forecasting performance of alternative modelling

methodologies can give some guidance. In addition, forecast purchasers can ask for (or undertake themselves) sensitivity analysis in which various assumptions can be varied and the implications for forecast values considered. This sensitivity analysis might vary the trends' values of various exogenous variables (for example, real growth in China will be four per cent instead of seven per cent), or it might vary the parameters within certain demand-and-supply relationships that reflect responsiveness to price or income changes.

Despite these cautions relating to the limitations applying to the usefulness of forecasts obtained from economic models, it cannot be emphasised too strongly that, except in special cases, this methodology will in principle deliver superior forecasts to those obtainable any other way. Leading-edge modelling methodology involves collecting and organising, in a logical and highly structured manner, vast bodies of data and insights into the behaviour of decision-makers across the economy. Generally speaking, the only way superior forecasts can be obtained is through the possession of superior information.

From time to time, individual business decision-makers will have 'inside information' that will enable them to forecast short-to-medium-term investment and employment for *their* business better than someone who does not have such inside information. Even then, this is definitely not a case against the use of the economic model since the owners of inside information will in general not be interested in the economy-wide ramifications of their decisions.

# 6 Comparison of Australian occupational forecasting methodologies

In previous sections we have considered the objectives of VET policy, the role of occupational forecasting in VET planning and policy as well as some of the characteristics required for an appropriate modelling methodology. We have also identified which modelling approaches have been and are currently being used to assist the VET sector, and discussed the manner in which model forecasts enter VET planning considerations. Finally, in the previous section, we provided a brief overview of some of the key concepts underlying the broad and relatively technical area of economic forecasting. We shall now turn to one of two central concerns of this report, a comparison of the major economic models that have been used in occupational forecasting.

## Previous comparative studies of economic models used in policy analysis

There are a number of studies which have compared and contrasted the range of economic models used in Australian policy formulation and analysis. For many years Australia has been at the forefront of economic modelling, the richness and range of the early models being captured in a special issue of *Australian economic papers* (Burns & Murphy 1988).

The models described and discussed in this volume ranged from the economy-wide models which vary substantially both in scale and in other important characteristics to single equation approaches and time series analyses, the latter embodying the least formal economic behavioural content. For reasons given above, our concerns in this report are limited to economy-wide models with a capacity for the substantial degrees of disaggregation necessary to generate reasonably detailed occupational forecasts.

In an important contribution to that volume, Wallis explained the types of international best practice benchmarks that, at the time, existed in world modelling centres such as the Modelling Bureau at the University of Warwick. He also emphasised how highly regarded by the international modelling community were Australian contributions in this area.

Since Australia's expertise in this area is widely recognised, the issue is not which of the current leading models is 'better'. Most models have been constructed with different objectives in mind and the more important question will be how the different objectives underlying alternative modelling approaches match the modelling requirements of the VET sector.

Most of the Australian modelling methodologies developed over time have been the subject of extensive and publicly available documentation which details the equations included in the model as well as the definitions of the variables used. This 'openness' is an essential requirement of the international modelling community: that it should be possible for other researchers to replicate the results and predictions derived from a particular model.

More recently, as economic modelling has become a serious commercial enterprise, the claim is often made that documentation cannot be fully released because it is of a commercially sensitive nature. Where model documentation is not made fully available it becomes impossible for independent judges to determine whether a particular model may or may not meet desired objectives, in this case, those of the VET sector. In such instances, potential

model-users will need to make a more limited judgement on the value of a particular model according to factors such as the historical performance of the modeller in question.

In fact, for most major Australian models, full documentation has been publicly available and this certainly is true of the two modelling methodologies (Monash and Murphy) most widely used by VET sector planners. Thus the Monash model has its origins in the seminal development of the ORANI model, first documented in Dixon et al. (1982). The progressive development of this methodology has been detailed in a large number of publications, some of which are discussed later in this section (for example Adams & Dixon [1995]).

Similarly, from its beginnings, documentation of different versions of the Murphy models has been widely available, for example in Murphy (1988a, 1988b, 1990) and Murphy et al. (1986). The origins of a third modelling framework which has been used in VET planning considerations, that of NIEIR, have also been substantially but not completely documented (Brain 1986).

An early comparison and detailed evaluation of these models was made in Burns (1990), although with objectives different from those relevant to VET considerations. That study was commissioned by the Bureau of Immigration Research with the specific objective of choosing a particular modelling framework for in-house use and analysis by bureau researchers. A major consideration was the impact of alternative broad policy initiatives on key macroeconomic variables and upon some more disaggregated variables, including occupational outcomes with respect to both wages and employment.

The broad conclusions of that study were that, although the ORANI predecessor to the current Monash framework was clearly a best practice framework for the determination of highly disaggregated outcomes, the then much less disaggregated Murphy methodology was also a best practice macroeconometric model, but one more amenable to understanding by well-trained economists who were not modelling specialists. At that time, however, the Murphy methodology could not derive disaggregated results and the advice to the bureau was that if disaggregated results were required, these should be purchased from specialist modellers using an ORANI-type framework.

Before attention is turned to the current state of the competing modelling approaches, some brief further comments on how well these earlier approaches might fulfill the kinds of model requirements for VET sector analysis such as those identified in section 3 above. Here it was made clear that VET planning requirements include information on *imbalances* between occupational demands and supplies. This in turn requires information about the dynamics of labour supply adjustment and takes into account factors such as workforce outflows, population growth and migration impacts, participation rates, skill composition of new entrants and labour supply substitutions, all of which reflect changes in wage relativities across occupations.

A problem here for the original ORANI-type frameworks, briefly signalled in section 5 above, is that in general, such models only predict the changes in occupational employment levels that will have occurred once all the markets in the economy have completed their adjustments—after all labour market imbalances have been 'adjusted away'. The most that might be 'inferred' from such models about occupational training needs is that where the largest changes in employment are predicted, there may be an associated 'training need'. Unless a model explicitly tries to take into account the different lengths of lag involved in labour supply adjustment across different occupations, however, they cannot actually yield information on the occupational area training resources most urgently required.

This problem does not simply apply to ORANI-type models, but to any 'general equilibrium' economic model, unless such a model has also taken into account lags of adjustment. This problem would exist both with very large-scale models such as ORANI and with far simpler models involving only a limited number of highly aggregated variables.

It should also be remembered that there is a separate problem related to adjustment, in that some occupational imbalances are of far more concern than others because increases in output for some product simply yield a 'better return' than is achieved through increases in other outputs. A more detailed discussion of these issues of model dynamics, as well as of the

treatment of expectations, is provided in Burns (1990) although this study does not address the issue of some output increases being more 'valuable' than others.

At the time of the Burns study, the ORANI model did not encompass even a minimally useful dynamic structure. In its conventional form it could yield insight into long-run changes in occupational employment but not into occupational labour market imbalances. In alternative 'short-run' mode, by assuming labour supply to be infinitely elastic, it could provide indicators of the changes in occupational labour demand, but again yield no critical information on labour market imbalances.

At that time, the NIEIR model was the major large-scale model alternative to ORANI. In the available documentation on that model Brain (1986), revealed it to be significantly smaller than ORANI, but with some important methodological differences to ORANI.

The general conclusion regarding the NIEIR model was that complete documentation was never made publicly available but, despite this limitation, the model incorporated some desirable features not incorporated into ORANI. These included a more flexible modelling of production process, allowing for other than constant returns to scale and relatively sophisticated dynamic adjustment processes, at least in some markets. Importantly, as recognised by the model's architect, the long-run behaviour of the model did not produce results with the characteristics generally regarded as appropriate within the modelling community.

The Treasury was also working upon a large-scale macroeconomic model at that time, as detailed in Department of Treasury (1981, 1984), Simes (1988) and Simes and Horn (1988). The focus of their modelling methodology was consideration of macroeconomic policy design, and at no stage was there a level of disaggregation sufficient for VET purposes. As noted in the Burns study, there were also widely expressed concerns with various aspects of the Treasury model(s) which may have contributed to the decision (reported in 1988 by Simes) that future Treasury work be directed towards a new but much smaller-scale (more aggregated) model. The documentation for this later model (TRYM) is given in Taplin et al. (1993a, 1993b).

When the comparative study by Burns was undertaken, the AMP or Murphy model of that time was a relatively small-scale macroeconometric model. It was, however, a cutting-edge model in terms of its basis in economic theory, its strong focus on the use of estimated (rather than ad hoc or imposed) parameters, and its sophisticated handling of dynamic adjustment and expectations.

While these early AMP and Murphy models would be far too aggregated for VET analysis, developments in modelling technology have seen the Murphy model achieve a significant disaggregated capability. Relatedly, the ORANI model has been developed to encompass some quite sophisticated dynamic adjustment, at least in certain key macroeconomic variables, as well as in the sectoral investment processes that drive change in the model. These Monash and Murphy developments have blurred the distinction between the two methodologies, although as will be seen below, there are important differences in relation to modelling labour market dynamics.

Before we turn to a more detailed examination of the current Monash, Murphy and NIEIR methodologies, one further aspect of occupational forecasting needs to be reinforced. As indicated in section 5, the quality and usefulness of occupational forecasts is dependent on two major factors: the ability of an economic model to capture the interrelated responses of decision-makers to policy changes and to internal or external 'shocks', and how well these policy changes or 'shocks' that drive the responses within the economic model can themselves be anticipated.

As also stated above, this second requirement is problematical because, almost by definition, 'shocks' normally involve unanticipated events. Notwithstanding this difficulty, particularly for a small trading economy such as Australia, occupational forecasts should take into account as far as possible, likely or plausible trends and adjustments in the world economy. In regard to these types of trends, a further Australian contribution may be of value, even though the modelling framework here yields insufficiently disaggregated information of the type required for VET purposes.

An excellent summary of the current state of global economic forecasting, and of the Australian contributions in this field, is available in McKibbin (1998). Of particular interest are the McKibbin MSG2 and G-Cubed dynamic intertemporal multi-country general equilibrium models. The MSG2 model builds upon earlier approaches described in Lipton and Sachs (1983) and McKibbin (1986) and is fully documented in McKibbin and Sachs (1991). Of further interest, a methodology has been developed which feeds the information regarding global economic trends and interactions drawing from MSG2 into a disaggregated model of the United States economy. A recent description of this development is given in McKibbin and Wilcoxen (1995).

The G-Cubed model is the subject of ongoing development and has three distinct forms, G-Cubed, G-Cubed (Asia-Pacific) and G-Cubed (Agriculture). The degree of internationalisation incorporated in these models together with the current extent of disaggregation is characterised in table 1. Although these models do not possess the degree of disaggregation required for VET purposes, they play an important role in the considerations that follow. This role is particularly associated with the second requirement of occupational forecasting described earlier—that occupational forecasting requires information regarding the major global trends driving the disaggregated outcomes within the Australian economy.

**Table 1: Global Intertemporal General Equilibrium Models**

| MSG2 | G-Cubed | G-Cubed (Asia Pacific) | G-Cubed (Agriculture) |
|---|---|---|---|
| **Countries:** | | | |
| United States | United States | United States | United States |
| Japan | Japan | Japan | Japan |
| Canada | Canada | Australia | Canada |
| Germany | New Zealand | New Zealand | Australia |
| United Kingdom | Australia | Korea | Canada |
| France | Rest of OECD | Rest of OECD | Mexico |
| Italy | China | China | Korea |
| Austria | EEFSU | India | EU12 |
| Australia | OPEC | Thailand | Rest of OECD |
| Mexico | Rest of world | Malaysia | ASEAN |
| Korea | | Singapore | Taiwan |
| High-income Asia | | Indonesia | China/Hong Kong |
| Low-income Asia | | Hong Kong | Rest of world |
| Rest of the EMS | | Taiwan | |
| Rest of the OECD | | Philippines | |
| OPEC | | OPEC | |
| EEFSU | | EEFSU | |
| Rest of world | | Rest of world | |
| **Sectors:** | | | |
| Single sector | Electric utilities | Energy | Food grains |
| | Gas utilities | Mining | Feed grains |
| | Petroleum refining | Agriculture | Non-grain crops |
| | Coal mining | Durable manufacturing | Livestock |
| | Crude oil & gas extraction | Non-durable manufacturing services | Processed good |
| | Other mining | Mining | Forest and fishery |
| | Agriculture, fishing | Energy | Mining |
| | Foresty & wood products | Textile and clothing | Energy |
| | Durable manufacturing | Non-durable manufacturing | Textile and clothing |
| | Non-durable manufacturing | Durable manufacturing services | Non-durable manufacturing |
| | Transportation services | | Durable manufacturing services |

Source: McKibbin (1998)

## The Monash model: Current status and planned developments

The Monash model is a dynamic general equilibrium model of the Australian economy which has its origins in the ORANI model discussed above. The model and its ongoing development are the focus of the activities of the Centre of Policy Studies (CoPS) at Monash University, Australia's largest and most influential modelling research centre. Since 1991, CoPS has developed particular expertise in the application of Monash methodology for obtaining detailed labour market forecasts. These forecasts are derived through a series of logical steps, fully described in CoPS (1999a).

The first of these steps involves obtaining forecasts of the trends in the major external (exogenous) variables driving the interrelated actions of decision-makers within the disaggregated model. These forecasts are based, in the first instance, upon the views about macroeconomic trends provided by Access Economics, a major private sector economic consulting organisation. It should be noted that a major tool used in the preparation of the Access Economics forecasts is an economic model with much in common with the early AMP or Murphy methodology discussed above.

These macroeconomic projections are then combined with a number of industry-specific forecasts produced by expert organisations, including the Australian Bureau of Agricultural and Resource Economics (ABARE), the Bureau of Tourism Research (BTR), the Productivity Commission (PC) as well as by CoPS itself.

This information is then incorporated into the Monash model to yield first of all, forecasts of growth in output and employment for each national industrial sector and in turn, disaggregated projections for the 56 statistical divisions of the Australian Bureau of Statistics. The resulting Monash projections for employment by industry and region are then further disaggregated to occupational level by means of the Labour Market Extension described in Meagher (1997). The final forecasts generated cover both hours worked and persons employed for classifications as disaggregated by the Australian and New Zealand Standard Industry Classification (ANZSIC) (3 digit or 158 industries) and the Australian Standard Classification of Occupations (ASCO) (4 digits and 340 occupations) classifications.

Since 1998 the Monash forecasts have been produced in conjunction with the Centre for the Economics of Education and Training (CEET) at Monash University. Related to the Monash forecasts is a quarterly briefing service incorporating two medium-term macroeconomic outlook presentations prepared by Access Economics and two labour-market specific presentations conducted by CoPS personnel. Subscribers to the briefing service in 1998 included ANTA, the Commonwealth Department of Employment, Education, Training and Youth Affairs (DEETYA) and education and training authorities from New South Wales, South Australia and Victoria.

Complementing the briefing service is a Windows-based CD-ROM which permits:

- user selection of forecasts of interest
- comparison of forecasts with recent historical data
- tabulation of data into Excel for further analysis
- shift/share analysis to assist identification of underlying economic forces

Planned future developments will enable users to identify the component effects of output growth, capital growth and different types of technological change.

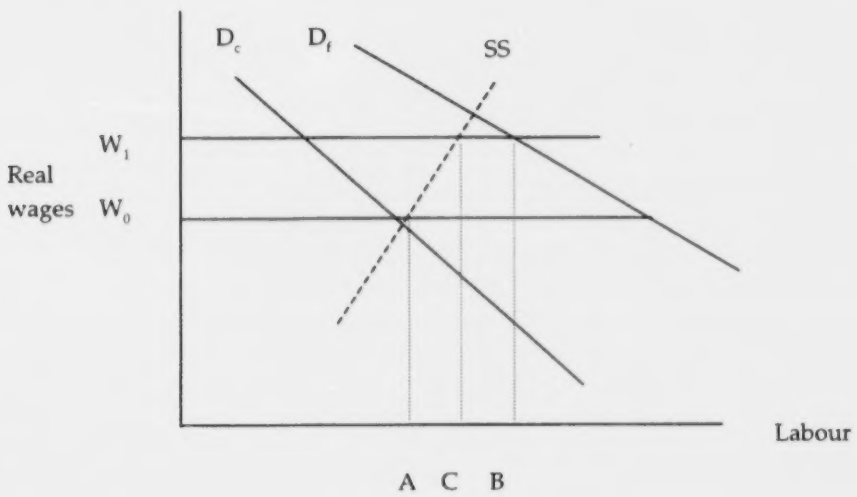
The point is also made (Centre of Policy Studies 1999a) that the Monash model has achieved considerable progress towards including dynamic processes at the disaggregated level, and further discussion of this issue is appropriate. In this respect, it is useful to distinguish between three areas where dynamics do or do not feature in the model: capital accumulation and its impact on productivity; labour market adjustment; and technological progress itself.

In relation to the first of these, the modelling is quite detailed and complex. First, businesses do not adjust to new desired capital stock level within a single period. Second, the speed of this adjustment varies from sector to sector in relation to the capital intensitivity of the technology in each sector, it being assumed that the more labour-intensive firms will view increased capital accumulation as a less risky option and will increase capital more quickly towards its desired level than will more capital-intensive firms. Third, there is a lag between investment expenditure and new capital becoming available as an input to production.

From a VET perspective, however, it is labour market adjustment that is more important, and in this respect the Monash model assumes a fairly simple process. Although capital accumulation does impact upon productivity and hence on labour demand, these impacts upon labour demand are likely to be small compared to direct product demand effects upon the labour demand curve. For this reason, in the stylised occupational labour market shown in figure 2 below, we shall not consider the (small) impacts upon labour demand due to capital accumulation and the associated adjustment lags discussed above.

Here the demand for labour is shown to have increased. We assume that this has occurred because of an increase in demand for the product. For expository purposes we will ignore the possibility of technological change impacting upon the labour market during the period of consideration here. What is assumed in the Monash model, as in the Murphy methodology discussed below, is that wages will change from one period to the next, wage relativities being preserved across sectors and occupations. Current and next period wage levels are denoted $W_0$ and $W_1$ respectively.

**Figure 2: Labour market imbalance: Allowing for labour supply and wage adjustment effects**




Within this framework the new desired level of employment (that is, desired by firms) will be given by the new labour demand curve, taking into account the new wage level. In terms of figure 2, desired employment will increase from A to B. What is derived in the Monash occupational forecasts reflects exactly these desired employment levels

In other words, and as clearly recognised in CoPS (1999b), the employment forecasts are essentially demand-determined and are conditional on the ability of all firms being able to attract all the labour required at the (new) going wage level. While it is true that significant progress has been made towards individual modelling of the required components of replacement demand and occupational labour supply, and undoubtedly it is also true that these factors will be incorporated into future Monash methodology, it remains that currently the model can generate, at best, high-quality forecasts of demand changes.

The difficulty with this approach is that it it is only useful to VET planners if the labour market imbalances and skill shortages are likely to occur in markets where the greatest labour

demand increases occur. This certainly need not be the case and what is required is information on both short-run and long-run supply-side behaviour. The problem here is readily identifiable in figure 2 above.

For the purpose of this explanation we may leave aside long-run supply considerations and focus on short-run supply behaviour expressed in the figure as SS. It is immediately clear that the required labour market imbalance is measured by the difference between employment levels B and C, and that this difference will vary in both magnitude and signv according to the short-run responsiveness of labour supply, measured by the slope of SS.

Ideally, the modelling of supply behaviour should also accommodate the changes in wage relativities that would seem likely to be the natural consequence of such imbalances. In some occupations employment may be increased quickly and without significant wage changes, but in other cases, because of other factors such as skill shortages and length of training required, declining relative wages or relocation costs (tangible and intangible), this need not be so. As made clear in our earlier discussions related to figure 1, what is required is the information as to how all of these supply-side factors vary from occupation to occupation. Only with this data is it possible to determine whether or not a particular labour demand increase has significant VET implications. Of interest, and as made clear in Centre for Policy Studies report, a priority research area for the Monash model has been identified as the development of an appropriate labour supply component.

In the Monash model, of course, productivity changes, whether due to capital accumulation or to technological change, also impact upon labour market decisions. Indeed, if the increase in productivity was greater than the increase in labour demand, the number of persons employed would fall. Technological change, rather than capital accumulation, is likely to be the major concern here, and in this modelling respect, Monash appears to be significantly ahead of its competitors. Despite the competitive nature of the economic modelling environment, the Monash methodology has been kept totally transparent to subscribers and no limitations regarding specification or planned developments were imposed in the context of information sought for the purposes of writing this report.

## Murphy methodology

As a result ongoing development processes, by the mid-1990s the Murphy methodology had become internationally regarded as being at the leading edge of macroeconometric modelling. Although there is a close relationship between the modern Murphy models (MM, MM2) and the earlier AMP model and related Access Economics model (AEM), we shall limit attention here to the better known MM and MM2 model.

The workings of a very recent version of MM are described in detail in Powell and Murphy (1997). This model is concerned with the behaviour of aggregated or macroeconomic variables and builds on the most widely accepted insights of modern macroeconomic theories in a coherent manner. From its beginnings extraordinary care has been taken with the dynamic behaviour of macroeconomic variables, and with modelling the way in which both expectations are formed and influence decision-making in the different sectors of the economy. A further desirable characteristic of econometric models retained throughout the development of MM has been, as far as possible, that parameters reflecting behaviour have been derived statistically from market data.

Although MM represents the cutting edge in macroeconometric modelling, it is worth remembering that, as with all models, the values of (endogenous) variables depend not only upon the properties of the model in question, but also upon the accuracy of the trend values assumed for the outside (or exogenous) variables driving the model.

As with the Monash methodology and forecasting services, Econtech (the Murphy model's parent organisation) provides detailed documentation accompanying their occupational forecasts and which elucidates the assumed values or trends of the outside (exogenous) variables. Murphy's occupational forecasts, however, are not and could not be derived simply from an aggregate model such as MM. Just as the Monash methodology has been developed

to add a macroeconomic component to its cutting-edge disaggregated base model, so MM has been augmented by a large, highly disaggregated multi-sector general equilibrium model.

These developments make the choice between Monash and Murphy methodologies quite difficult, the broad approaches to forecasting disaggregated variables becoming increasingly similar. Powell and Murphy (1997) argue that the augmented Murphy model (MM2), as well as G-Cubed models discussed above, reflect a distinct methodological advance over the Monash models in the manner they have integrated disaggregated and aggregated market outcomes.

From the point of view of VET sector requirements, these subtle theoretical distinctions are probably not of fundamental importance. Bearing in mind that the real VET interest is in being able to predict micro-labour market imbalances, the comparative labour market dynamics of the two approaches is far more central and here there lies an important distinction.

Again with reference to the stylised figure 2, the increased demand for labour can be conceived as primarily being driven by an increased product demand which is also likely to stimulate additional investment, which may in turn increase labour productivity and make additional employment profitable. As before, for expositional purposes, we shall ignore these productivity effects on labour demand.

Further similarities between the Monash and Murphy dynamics arise in that aggregate wages adjust in each period, although perhaps, with the Murphy model giving more weight to a formal expectations-augmented Phillips Curve framework. Again, the new desired employment level will be given for each occupation by the labour demand curve, given the new wage level. But here lies the difference.

For Monash, as discussed above, the lags in adjustment related to capital accumulations and its relatively minor effects upon productivity and labour demand. For the Murphy methodology, lags are actually introduced into labour market adjustment, at least at the industry level. That is, for each industry, it assumed that each firm will only be able to adjust partially towards the desired employment level. In terms of figure 2, while both Monash and Murphy methodologies agree that firms would like to adjust employment from A to B, in the Murphy framework the actual employment expansion would be a smaller amount, perhaps closer to the adjustment from A to C rather than that from A to B as assumed for Monash.

A positive feature of these Murphy dynamics is that the degree of difficulty of labour market adjustment is derived from statistical analysis of data for each of the industrial categories. Thus the Murphy forecasts embody the characteristic that, on average, labour adjustment will be slower in some sectors than in others. Even though this adjustment capability has not been based upon the range of supply considerations indicated to be relevant in our discussions above, the method is still a fundamentally useful way of putting some broad measure on overall adjustment difficulties in different sectors. Information about these adjustment capacities in different occupations is, of course, exactly the kind of information required by the VET sector.

Unfortunately there are a number of difficulties with this approach that need to be addressed. First, as admitted in Powell and Murphy, the data required to estimate lags in employment adjustment are only available at industry division level. To obtain more disaggregated results than for the 18 ANZSIC divisions it is necessary to assume that the dynamic adjustment parameters derived for a particular division apply for each of the sectors and occupations within the divisions. This is problematic, not least because, for example, if labour market imbalances are related to skill shortages, then one might expect adjustment lags to differ between skill and unskilled categories and occupations within the same division or sector.

Again, in relation to skill shortages, it is not clear why adjustment difficulties should be symmetrical. If appropriately skilled labour is unavailable, expansion of employment simply may not take place while decreases in employment are clearly not constrained to the same extent.

Notwithstanding these cautions, the overriding view would be that the adjustment parameters derived in the Murphy methodology contain information that is potentially useful to the VET sector. To extract this potential, however, it appears necessary for the Murphy results to be presented differently. The Econtech Outlook currently takes into account adjustment lags in deriving employment forecasts, but no information is actually presented about these lags or adjustment parameters. Only the employment forecasts are presented.

The difficulty here is that if an occupation is characterised by severe adjustment difficulties, very little employment growth will be forecast. As the results are presented, however, all that VET planners would observe is the small employment change forecast and therefore assume that this was not a priority sector. Clearly, what is needed for VET planners is the implied imbalance information that would follow from a statement regarding the initial employment change, and the predicted whole employment change once all adjustment has taken place.

As it turns out, it would be straightforward for this potentially useful information to be made available. Because of data limitations, however, it will remain much more difficult to obtain more finely disaggregated adjustment information. In this respect it is also true that neither the current Murphy nor the Monash methodologies consider the possibility, and the effects upon adjustment, of changes in wage relativities between sectors and occupations.

Econtech offers a wide range of forecasting services to clients, but while a close working relationship is retained with these clients, at present no interactive CD-ROM is supplied in conjunction with the employment profiles. There is no reason, however, why Econtech subscribers should not have access to a similar interactive tool as is available to users of Monash, should the demand for this feature arise.

## The NIEIR model

As indicated in section 4 above, one of the States (Queensland) has made limited use of the NIEIR methodology although it was reported that they were uncertain how far the employment projections obtained were based upon the IMP model and developments explained in Brain (1986). The reasons for the more limited attention paid to NIEIR modelling in this report are outlined below.

First, the information from the Queensland training authority is not particularly encouraging. The employment projections from the NIEIR were only disaggregated to the level of the 56 ABS industry sub-divisions and further, as indicated above, were found to be somewhat less accurate than the Monash forecasts.

As indicated above and also as spelled out in detail in Kettle (1996), progress has been made in Queensland towards the development of an increased in-house modelling capability, specifically a framework incorporating a more detailed consideration of both the demand for VET and the range of factors impacting upon the supply side of occupational labour markets.

Second, the degree of detail relating to NIEIR projections is not as well documented as the more widely used Monash and Murphy models. The advice given by the NIEIR was that the logic behind current projections is significantly captured in Brain (1986, 1999). It is thus unclear whether model development has overcome the perceived limitations regarding overall model coherence that were detailed in Burns (1990). Even if the developments necessary to meeting standard modelling criteria have taken place, there is no basis for assuming that the NIEIR model yields any information about imbalances in the different labour markets.

This is not to suggest that the NIEIR methodology is not without its uses. Any forecasting unit that has been able to support itself commercially for a period of more than fifteen years has obviously been providing a valued service to a significant number of clients. As discussed earlier, the usefulness of economic forecasts must derive from both a model that captures the decision-making behaviour of units adequately and the interactions of the decisions made, as well as accurate forecasts of the external trends driving the behaviour of these decision-makers.

It is in this latter respect, described by Brain (1999), that the NIEIR methodology has an original and distinctive dimension. It nevertheless holds true that, where there is inadequate documentation for making judgements about the appropriateness of the methodology that forms the basis for various projections, then the criteria for model selection must solely be forecasting performance. Here attention must not focus only upon claimed individual spectacular successes, but also upon performance over all forecasts made.

## Other modelling methodologies

The importance of identifying training needs has been recognised worldwide and Australian modellers acknowledge the developments made in Europe and North America, especially the contributions of Hughes (1991, 1993, 1994) as well as Boothby, Roth and Roy (1995) and others associated with the Canadian Occupational Projection System (COPS), Borghans and Heijke (1993) Willems and de Grip (1993), Borghans (1994), Heijke (ed.) (1994).

Common threads run through this work and for the purposes of this report attention will be focussed upon the COPS development undertaken by the Applied Research Branch of Human Resources Development Canada (HRDC). HRDC is effectively the sole supplier of Canadian occupational projections. It is useful to distinguish two phases in COPS development. The pre-1994 COPS framework grew out of the manpower planning requirements of the 1950s and 1960s. This followed the common approach of a macroeconomic scenario driving the growth in production across industrial sectors. Drawing on a mathematically simple model of production technology, employment growth was derived from these production projections.

In discussing the need to develop an improved framework for occupational forecasting, Boothby, Roth and Roy recognise both the uncertainty of whether these projections reflected growth in employment or simply employment demand and the need to develop an appropriate supply-side framework. Thus COPS was originally a demand-side model like Monash, but much less disaggregated and involving a far simpler and less satisfactory model of production technology.

Drawing on methodology developed by Willems and de Grip among others, major enhancements were made to COPS in the mid-1990s, especially with regard to the supply behaviour. Full attention is given to the range of factors such as the impacts upon the labour force of school leavers, of immigration and of re-entrance. A range of imbalance indices are derived according to occupation and type of education; risk factors are also considered.

In a number of respects the output of the modern COPS framework is clearly far more closely attuned to VET planning needs than is the output of the Monash and Murphy models. There are important limitations to COPS, however, some of which derive from the quite distinct modelling methodology. The linchpin of COPS is not the identification of demand and supply separately within a general equilibrium framework, but the identification of changes in occupational labour demands and supplies. The empirical basis for these projections is not estimation of the parameters of conventional demand–supply relationships, but the estimation of a transition matrix modelling the range of flows from one supply category to another, from one period to the next. A critical element of this matrix is the availability of detailed labour force survey data.

In this brief review of COPS, both encouraging and more problematic issues can be identified. The type and quality of output has been warmly received by the Canadian equivalent of VET planners. As Boothby and Roth recognise, however, a major weakness is, that while changes in demand and supply are derived, the methodology is silent on initial labour market conditions. Thus, if the initial condition in a particular market is one of significant excess supply, the identification of a net increase demand does not necessarily indicate additional training needs.

There appear to be other areas where the COPS framework shares limitations with Monash and Murphy or, in some cases, is actually inferior. None of the approaches accommodate the changes in wage relativities that are a likely consequence of occupational labour market imbalances. In terms of the detail and sophistication of micro-market modelling, however,

there is no evidence that the COPS framework can deliver demand-side projections of a quality remotely comparable with the Monash or Murphy models, nor does the available documentation suggest that COPS has a macroeconomic dimension comparable to these Australian models.

# 7 Summary and policy recommendations

The substantial economic literature on labour market behaviour and policy both identifies reasons for public sector intervention in the VET areas and defines the appropriate form that intervention should take. At present, neither VET policy formulation nor performance measurement appears to have made use of the insights available from this literature.

Specifically, VET policy needs to be guided by an understanding:

- of the role of information regarding likely future occupational labour market imbalances in improving investment decisions by employers as well as by current and potential future employees
- of the circumstances under which public sector intervention should go beyond the provision of information
- that, even where there are similar skill shortages in similar firms or industries, it is likely to be more valuable to remove some imbalances than others

It is clear that the national and State agencies concerned with the design and application of VET policy need, within their organisations, some expertise in the application of economic analysis, modelling and forecasting to VET issues. A survey of users' views and practices suggested that this expertise was not always available and that the use of labour market models in planning processes was at best, ad hoc and at worst, ignored.

The information that would guide private sector decision-making is, of course, the same kind of information required to identify those sectors where public support for training activities should be focussed, providing such support is justified. The extent of such information is significant, covering both occupational demand and supply data at highly disaggregated levels. It is not clear how this information could usefully be derived without the use of an appropriate large-scale multi-sector economic model.

Despite the well-understood limitations in all economic modelling approaches, informed use of the outputs of best-practice modelling methodology is clearly an essential ingredient of VET policy design and application. Australia is a world leader in the development of the multi-sector models of the type relevant to VET policy. In particular, two models have been developed that substantially satisfy the modelling criteria generally agreed to be desirable in the international modelling community. These are the Monash and Murphy models, already widely used in the VET sector.

Each of these models, in slightly different ways, yields information that is useful to some degree for VET sector planning. However at this stage, both models work with fairly primitive labour market supply-side considerations. In simple terms, the Monash model yields useful predictions about likely increases *in demand* across occupations to the level of the ASCO unit group classifications, but based upon the simplifying assumption of perfectly elastic labour supply. The somewhat similar Murphy model provides predictions down to a similar level of disaggregation, but does allow for some labour market supply-side response, albeit through an ad hoc lagged adjustment process. At the time of writing, the Murphy results are not reported in a way that makes full use of the information regarding labour market adjustment.

The quality of the predictions obtained from any model does not simply depend upon the accuracy of the model in capturing the behaviour of decision-makers within the economy and in describing the interactions between different markets in the economy. They also depend

upon the accuracy in predicting the shocks that will impact upon the economy. It is in this respect that a further leading-edge Australian modelling methodology is worthy of note. The smaller-scale multi-country G-Cubed models developed by McKibbin offer a valuable framework for identifying more adequately how changes in the international economic environment are likely to impact upon different countries. A possible supplement to the Monash and Murphy frameworks would be the supply of information from the McKibbin suite of models. In this way the prediction of some of the shocks that will drive future changes within the Australian economy could be enhanced.

Notwithstanding this possibility, the priority research area for the Monash and Murphy modelling frameworks is an improvement in the specification of labour market dynamics, especially with regard to the treatment of occupational labour supply and replacement demand, as well as to likely occupational wage adjustments. Thus the capacity to forecast occupational imbalances would be improved.

Occupational forecasting methodology, such as that undertaken in Canada and which has a far more detailed consideration of labour supply processes, may provide pointers for labour market supply-side developments in Australian models. This would probably be the only useful aspect of current Canadian occupational modelling methodology, which is both limited in its demand-side modelling and is unable to identify whether the predicted occupational labour market flows take place in environments of skill shortage or excess supply.

Despite the limitations identified in all current occupational forecasting methodologies, a more informed use of the best of these methodologies, combined with a process of ongoing development is clearly the best way forward. The coherent organisation of theory, understanding and data within a modelling framework will always offer a superior method of multi-sector forecasting than the unstructured use of 'expert' opinion on particular organisations or sectors.

## Policy recommendations

1 Drawing on the insights available from models of labour market behaviour and economic policy analysis, the role of the public sector in some VET sector activities, specifically those relating to labour market supply and demand, should be reconsidered, with a view to clarifying:

- ❖ whether the focus of the public sector should be to provide information on projected labour market imbalances in order to improve industry decision-making in the various occupational labour markets
- ❖ under what circumstances projected imbalances can be addressed efficiently through private sector demand-side and supply-side decisions, without public sector interventions in these markets
- ❖ for those occupational labour markets where public sector interventions (other than information provision) can be justified, the basis upon which the relative importance of imbalances in different markets can be established

2 On the basis of the first point above, ANTA should review its definitions of the objectives of VET policy and of the key performance measures that derive from policy objectives.

3 It is desirable that the national and State agencies concerned with the design and application of VET policy maintain within their organisations, some expertise in the application of economic analysis, modelling and forecasting to VET issues.

4 A key research priority is to improve the labour market dynamics of models, especially in regard to the treatment of occupational labour supply and replacement demand, as well as to likely occupational wage adjustments. In this way, the capacity to forecast occupational labour market imbalances will be increased.

5 A further research priority is to develop the model's capacity to indicate the relative value of reducing labour market imbalances for one occupation as opposed to another.

6 It is desirable that the research priorities identified in 4 and 5 above be undertaken in a way that utilises the leading-edge skills of the Australian economic modelling community, especially those exemplified by the Monash and Murphy methodologies.

7 Incentives should be provided for a focussed program of research which, while encouraging further developments on the Monash and Murphy models, should avoid encouraging duplication of research activity between different modelling agencies.

8 The possibilities for collaborative model development should be explored but not to the extent of precluding an ongoing process of model comparison and evaluation.

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# Appendix

## Useful Internet sites (July 1999)

### National

| | |
|---|---|
| www.anta.gov.au | ANTA's site |
| www.deetya.gov.au | DEETYA |
| www.ncver.edu.au | NCVER |
| www.rcvet.uts.edu.au | A research site based at the University of Technology, Sydney |
| edx1.educ.monash.edu.au/centres/CEET/ | The Monash site |

### State

Several of the State governments have established web sites.

| | |
|---|---|
| www.otfe.vic.gov.au | The Victorian Government site |
| www.training.wa.gov.au | The Western Australian Government site |
| www.bvet.nsw.gov.au | The New South Wales Government site |
| www.dvet.tas.gov.au | The Tasmanian Government site |
| www.nt.gov.au/nteta/ | The Northern Territory Government site |
| www.detir.qld.gov.au | The Queensland Government site |
| www.tafe.edu.au | The South Australian site |

NCVER

The National Centre for Vocational Education Research is Australia's primary research and development organisation in the field of vocational education and training.

NCVER undertakes and manages research programs and monitors the performance of Australia's training system.

NCVER provides a range of information aimed at improving the quality of training at all levels.

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